

## 12. COMPLIANCE TEST EXECUTION...Continued

### SORL LOCATION ON THE STANDARD SEAT

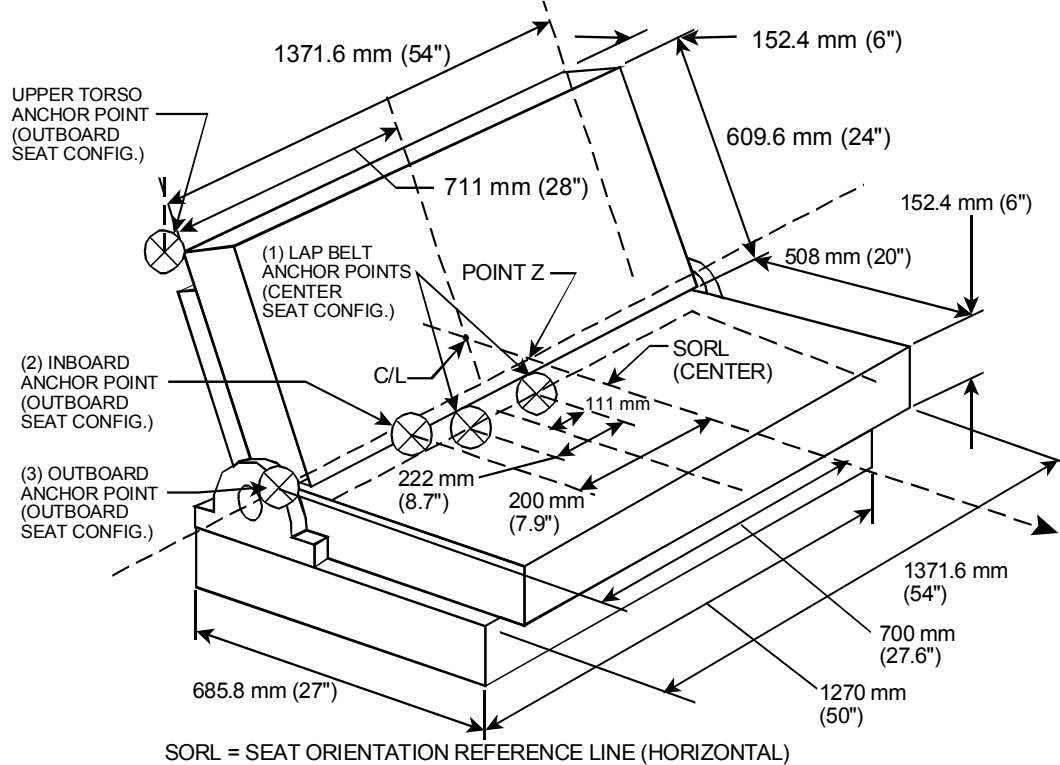


FIGURE 15

### LOCATIONS OF BELT ANCHORAGE POINTS AND FORWARD EXCURSION LIMIT

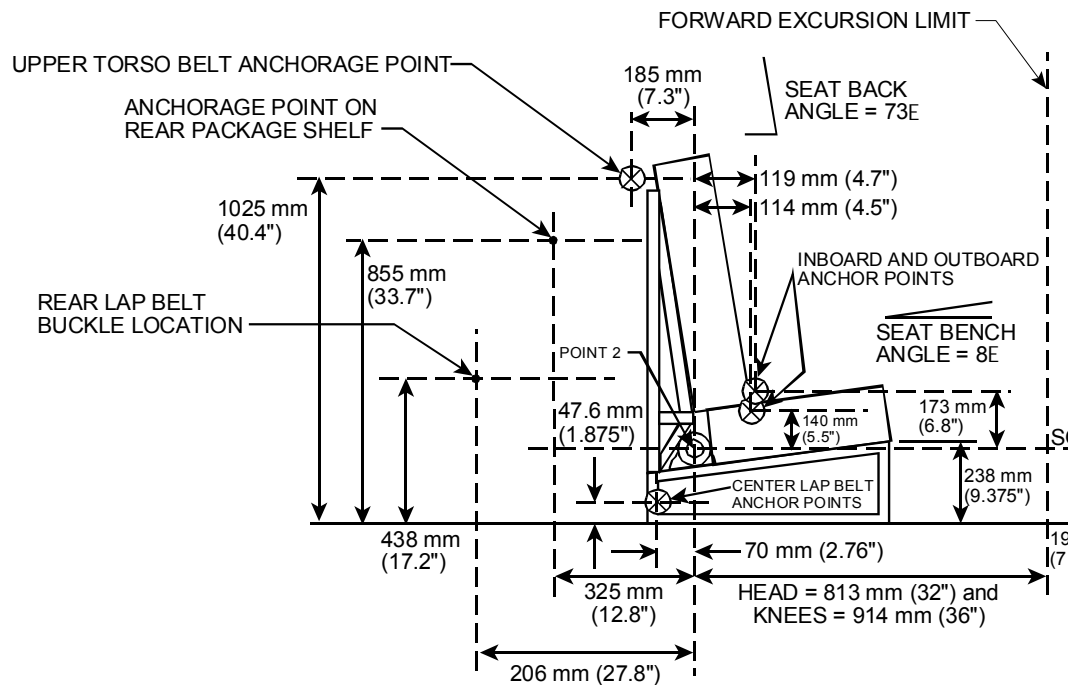


FIGURE 16

## 12. COMPLIANCE TEST EXECUTION....Continued

### D.1.2 INSTRUMENTATION

#### TRANSDUCERS (S213, S5.1.2, S6.1.1.1, S7.2)

The following transducers are required:

- (1) Accelerometer for monitoring impact sled deceleration.
- (2) Two triaxial accelerometer packages for mounting one each in the head and the thorax of the three-year-old dummy. Six accelerometers are required for mounting, three each in the head and thorax of the six-year old dummy. Each axis of the accelerometers shall meet the following minimum performance requirements:

Mounting frequency response:  $\pm 5\%$ , 0 to 2000 Hz

Maximum damping: 0.005 of critical, nominal

Transverse sensitivity: 5% maximum

Linearity and hysteresis:  $\pm 3\%$  of reading, maximum

Dynamic range:  $\pm 500$  g, minimum

- (3) Seat belt webbing load cells to monitor belt preload during seat installation. This item is not required if an equivalent belt tension measurement device is utilized to determine the preload on the Type I and Type II seat belt assembly.
- (4) Velocity transducer or integration of the sled accelerometer to determine speed of Dynamic Impact Test.
- (5) Force transducer to monitor the load applied to the dummy sling during the Buckle Release Tests described in this procedure.
- (6) Force transducer to measure buckle release force.

#### PLAYBACK AND RECORDING EQUIPMENT

Equipment shall be provided that has the following capabilities:

- (1) Have a minimum capability of 8 data channels for measuring the following during the Dynamic Impact Test:

## 12. COMPLIANCE TEST EXECUTION....Continued

6 - Dummy accelerations

1 - Sled acceleration

1 - Sled velocity

- (2) Provide a permanent record of all data channels during dynamic impact.
- (3) Provide a permanent record of seat belt preload.
- (4) Provide a permanent record of force applied to the dummy sling during the Buckle Release Tests described in this procedure.
- (5) Provide a permanent record of buckle release force.

### HIGH SPEED CAMERAS

At least three (3), on board 16-mm high-speed movie camera or video capable of 1,000 frames per second (fps) is required to record the dynamic performance of the child restraint system. The movie film/video will be analyzed to determine occupant excursions as outlined in this procedure.

In order to obtain a complete view of the restraint system behavior during the entire test, a large field of view is required. An onboard camera system is suggested for maximum resolution of head and knee-target excursions of the three-year old and six-year old dummy. For a typical sled configuration, a single onboard camera mounted 182.9 cm (6 feet) from and perpendicular to the SORL, with its optical axis approximately 635 mm (25 inches) above the base plane of the standard seat assembly and 864 mm (34 inches) forward of the seat back pivot axis, will provide a suitable arrangement for accurately assessing the excursions near the 813 mm (32-inch) head limit and the 914 mm (36-inch) knee pivot-point limit. If a single camera is used, a 13-mm lens mounted as suggested above will have a field of view approximately 1499 mm (59 inches) wide and 1067 mm (42 inches) high. When placed at the 864 mm (34-inch) location, the camera will cover the initial installation configuration of the test as well as the maximum forward motions of the restraint system and dummy.

For built-in child restraint systems using the specific vehicle for the dynamic Test it is suggested that a minimum of two 16 mm high-speed movie camera or video capable of 1000 frames per second (fps) be utilized on board the vehicle. The location of the camera must be perpendicular to the SORL and placed on the outdoor skin of the vehicle at a known distance forward of the child restraint system. Because of the vehicle construction and obstructions (B pillar, front seats, etc.), the camera cannot be placed 864 mm (34 inches) forward of the seat back pivot as suggested above, therefore, the camera must be located at an accurately measured distance forward of the restraint system so the forward excursions can be measured with a minimum of error.

## 12. COMPLIANCE TEST EXECUTION....Continued

For a test of a forward-facing restraint in which the target point on either side of the dummy's head is above the top of the standard seat assembly, a second camera is required for observing the rebound phase of the test. This camera should be mounted at the same height and distance from the SORL as the first camera but directly above the seat back pivot axis. Insure that the field of view of the camera includes a vertical reference.

The limiting resolution of typical onboard camera/film systems is approximately 40 line-pairs per millimeter (mm). With a 1499 mm (59-inch) by 1067 mm (42-inch) field of view, the corresponding lower limit on position-resolution capability is 3.8 mm (0.15 inch). Any angle determinations made from reading the positions of two targets will also be affected by the resolution limit. This uncertainty can be minimized by placing targets as far apart as possible.

Place a rigidly fixed reference grid on the far side of the standard seat assembly, with field calibration targets and head and knee pivot-point limit lines displayed vertically on it. The vertical limit lines should be positioned to account for parallax such that, when the head leading-edge or knee pivot-point reach those lines in the camera field of view, they have exceeded their excursion limits beyond any question of experimental error. This will allow a simple PASS or FAIL determination to be made before the excursions are actually measured. Even though the knee pivot-points are on either side of the SORL, the placement of the camera at 864 mm (34 inches) will result in such a small parallax error that a single line can be used for determining the excursion of either knee pivot-point. The vertical grid lines will also serve as reference for the measurement of the back support angle of rear-facing restraints.

For built-in child restraint systems using the specific vehicle, a rigidly fixed reference grid should be placed in the vehicle in line with the onboard camera. This reference must be a known distance from the seat back pivot point.

If an alternate method of comparable accuracy is available for observing and measuring occupant excursions, this method may be used instead of a high-speed movie system with the concurrence of the COTR.

### D.2 SYSTEMS CHECK

Before beginning a series of child restraint system compliance tests, conduct one trial test to determine that all systems are functioning properly. In particular:

- (1) Ensure the test velocities and severity conditions given in this procedure are met.

## 12. COMPLIANCE TEST EXECUTION....Continued

- (2) When applicable, conduct the trial test with an instrumented dummy to assure correct operation of transducers, signal conditioning, and record/playback equipment.
- (3) Review high-speed movie coverage of the test setup and timing of the camera operation.
- (4) Ensure accurate calibrations of the high-speed movie field of view are available in the plane of motion of the child restraint system.

### D.3 TEST CONDITIONS

#### D.3.1 ENVIRONMENTAL CONDITIONS (S213, S6.1.1(d))

The Dynamic Impact Test shall be performed under the following environmental conditions:

Temperature	19°C (66°F) to 26°C (78°F)
Relative Humidity	10% to 70%

#### D.3.2 IMPACT SPEED (S213, S6.1.1)

Configuration I tests of proper restraint usage shall be conducted at an impact speed of 48 km/h, + 0, -3.2 km/h (30 mph, + 0, - 2 mph), or for the specific vehicle test with the deceleration produced in a 48 km/h frontal barrier crash.

Configuration II tests of restraint misuse mode shall be conducted at an impact speed of 32 km/h, +0, -3.2 km/h (20 mph, + 0, - 2 mph), or for the specific vehicle test with the deceleration produced in a 32 km/h frontal barrier crash.

The test facility must establish a target impact speed, which, with all equipment and instrumentation accuracies considered, ensures that the actual speed is within the tolerance band. The target speed should be the maximum possible and still meet the required criteria. The target speed must be reported to the COTR prior to starting the testing program.

#### D.3.3 IMPACT SEVERITY (S213, S6.1.1)

The impact sled acceleration function envelopes shown in Figures 17 and 18 are defined by the coordinates in Tables 1 and 2.

## 12. COMPLIANCE TEST EXECUTION....Continued

The sled acceleration shall not exceed the upper limit of the appropriate envelope at any time. The sled acceleration may exhibit short-duration deviations below the lower limit of the envelope provided the integrated total of such deviations does not exceed 0.13 meters per second (0.44 feet per second) for Configuration I or 0.09 meters per second (0.29 feet per second) for Configuration II.

TABLE 1  
TEST CONFIGURATION I  
ACCELERATION FUNCTION ENVELOPE

TIME (MS)	UPPER LIMIT ACCEL.(G'S)	LOWER LIMIT ACCEL.(G'S)
0	0.0	-2.5
10	22.0	17.0
14	23.5	19.5
20	24.0	21.0
28	23.0	19.2
33.5	20.5	17.6
48	20.25	17.5
58	18.5	16.0
66	15.0	11.5
72	10.0	5.0
81	0.0	-3.0

## 12. COMPLIANCE TEST EXECUTION....Continued

TABLE 2  
TEST CONFIGURATION II  
ACCELERATION FUNCTION ENVELOPE

TIME (MS)	UPPER LIMIT ACCEL.(G'S)	LOWER LIMIT ACCEL.(G'S)
0	0.0	-2.0
9.5	14.0	9.4
14	17.0	13.5
20	17.7	14.0
32	16.5	12.5
40	14.8	11.0
44	15.3	11.5
50	15.0	11.5
60	12.0	9.0
66	9.0	6.0
72	5.0	2.0
76	0.0	-2.0

## 12. COMPLIANCE TEST EXECUTION....Continued

### CONFIGURATION I ACCELERATION FUNCTION CURVE

ACCELERATION FUNCTION FOR  $\Delta V = 30$  mph

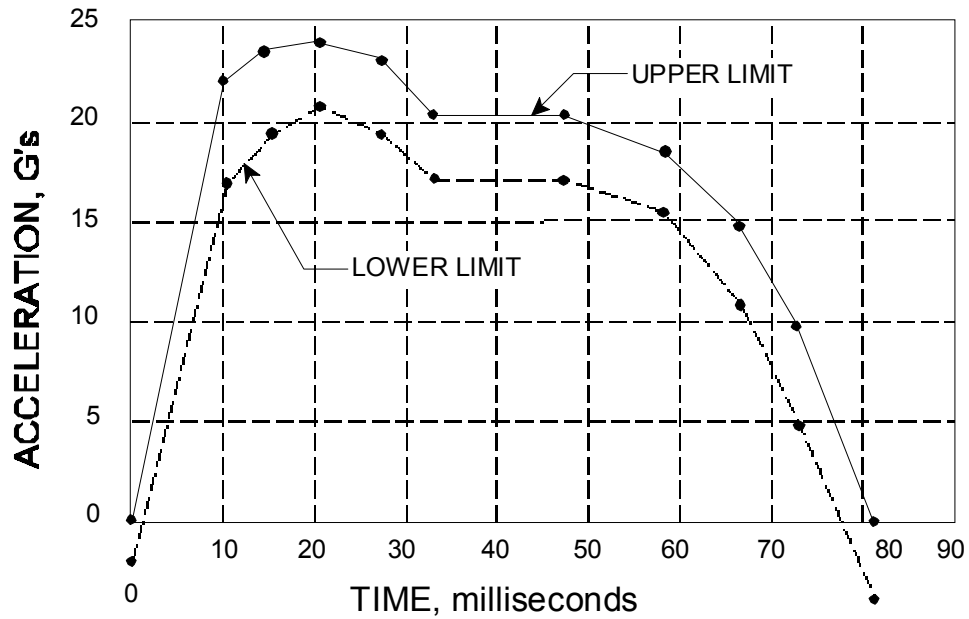


FIGURE 17

### CONFIGURATION II ACCELERATION FUNCTION CURVE

ACCELERATION FUNCTION FOR  $\Delta V = 20$  mph

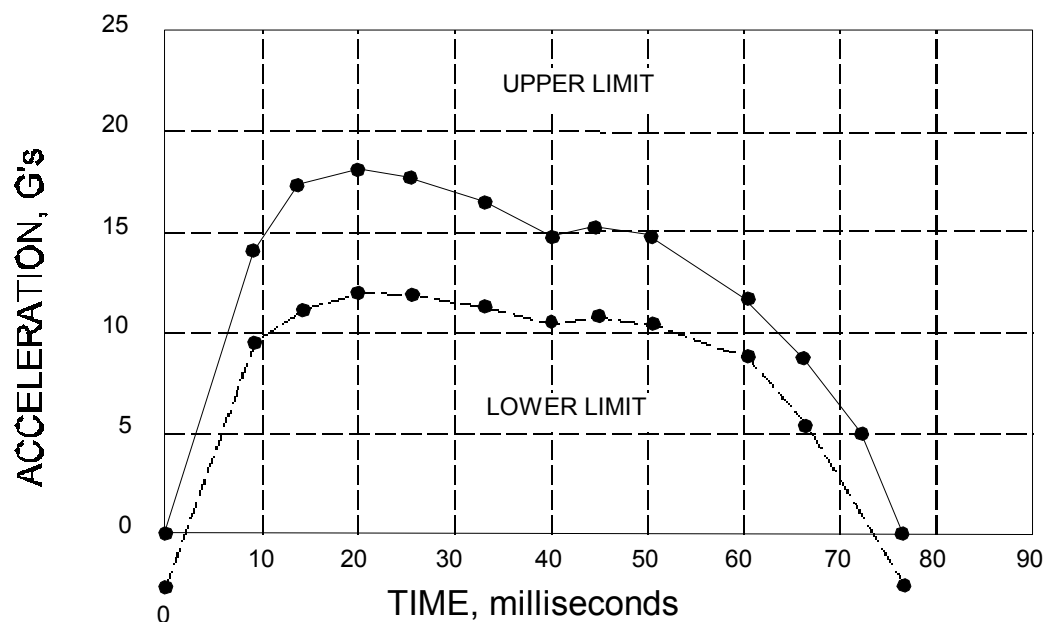


FIGURE 18



## 12. COMPLIANCE TEST EXECUTION....Continued

### D.4 DUMMY PREPARATION

#### D.4.1 DUMMY SELECTION (S213, S6.1.2.3, S7.2)

Determine whether to use the newborn, nine-month-old, three-year-old dummy or the six-year-old dummy based on the manufacturer's label information for occupant weight class.

A child restraint that is recommended for children having a specific mass range or height range shall use the tested child restraint according to the following table.

TABLE 3  
DUMMY SELECTION BY MASS AND HEIGHT

MASS	HEIGHT	DUMMY
5 kg	650 mm	Newborn Part 572 (K)
> 5 kg, 10 kg	> 650 mm, 850 mm	Newborn Part 572 (K) Nine-Month-Old Part 572 (J)
> 10 kg, 18 kg	> 850 mm, 1100 mm	Nine-Month-Old Part 572 (J) Three-Year-Old Part 572 (C)
> 18 kg	> 1100 mm	Six-Year-Old Part 572 (I)

#### D.4.2 PRETEST CONDITIONING

##### NEWBORN DUMMY (S213, S9)

Place the dummy on its back on a flat, horizontal surface, and hold the torso firmly in position. Limber the dummy legs by lifting both feet and rotating the legs until the feet touch the dummy head and the legs contact the torso. Release the feet slowly and do not push them back toward the horizontal surface. During bending of the legs, head or arms during pretest conditioning apply a load along the axis 44.5 - 66.7 N (10 - 15 lbs.) of the segment to determine if the skeleton material is torn.

##### NINE-MONTH OLD DUMMY (S213,S9)

Calibrate the TNO 9 month old dummy according to the requirements of 49CFR 572 Subpart J as described in Appendix A of this procedure, before testing begin, after an apparent non compliance, and regularly at six month intervals. Ensure the dummies limb joints remain adjusted between the 1g and 2g force setting before each test.

## 12. COMPLIANCE TEST EXECUTION....Continued

### THREE-YEAR-OLD AND SIX-YEAR-OLD DUMMY (S213, S9)

Calibrate the three-year-old and six-year-old dummies according to the requirements of 49 CFR 572, Subpart C and I respectively, as described in Appendix B and C of this procedure, before testing begins, after an apparent noncompliance, if the dummy has been in storage for thirty (30) days or more during a testing program and after thirty (30) tests have been performed on that dummy. In addition, the dummy is limited to one test per hour in order to allow dummy thorax to recover from test deformation. Ensure the dummy's limb joints remain adjusted between the 1g and 2g force setting before each test.

#### D.4.3 DUMMY INSTRUMENTATION

##### NEWBORN DUMMY

No instrumentation is installed in the newborn dummy.

##### NINE-MONTH-OLD DUMMY

Instrumentation for this dummy is optional and will be used at the discretion of the COTR.

##### THREE-YEAR-OLD DUMMY

Two triaxial accelerometers are used to instrument the three-year-old dummy. One is installed in the dummy's head and one in the dummy's thorax per the requirements of 49 CFR 572, Subpart C.

##### SIX-YEAR-OLD DUMMY

Six accelerometers are used to instrument the six-year-old dummy. Three are installed in the dummy's head and three in the dummy's thorax per the requirements of 49 CFR 572, Subpart I.

#### D.4.4 DUMMY CLOTHING (S213, S9)

##### NEWBORN DUMMY (S213, S9.1(a))

The newborn dummy is tested unclothed.

##### NINE-MONTH-OLD DUMMY (S213, S9.1(b))

The dummy is clothed in terry cloth polyester and cotton size 1 long sleeve shirt and size 1 long pant, with a total mass of 0.136 kg (.3 lbs).

## 12. COMPLIANCE TEST EXECUTION....Continued

### THREE-YEAR-OLD AND SIX-YEAR-OLD DUMMY (S213, S9.1(c))

The three-year-old dummy is clothed in thermal knit waffle-weave polyester and cotton underwear, a size 4 long-sleeved shirt (three-year-old dummy) or a size 5 long-sleeved shirt (six-year-old dummy) having a mass of 0.91 kg (0.2 lbs), a size 4 pair of long pants having a mass of 0.91 kg (0.2 lbs) and cut off just far enough above the knee to allow the knee target to be visible, and size 7M sneakers (three-year-old dummy) or size 12 1/2M sneakers (six-year-old dummy) with rubber toe caps, uppers of Dacron and cotton or nylon and a total mass of 0.45 kg (1 lbs). Machine-wash the clothing, other than the shoes, in 71°C (160°F) to 82°C (180°F) water, and machine-dry at 43°C (110°F) to 54°C (130°F) approximately 30 minutes. Shirt sleeve may be cut off at the elbows to improve the visibility of the dummy head during maximum excursion.

#### D.4.5 DUMMY TARGETING

##### NEWBORN DUMMY

Photographic targets are required to identify the head. Adhesive backed paper or fabric targets with a pattern that facilitates identifying and tracking the head in the high speed movies are recommended.

##### NINE-MONTH-OLD DUMMY

Photographic targets are required to identify the head center of gravity of the nine-month-old dummy, which is located on either side of the dummy head at the head accelerometer mounting block bolt. Adhesive backed paper or fabric targets with a pattern that facilitates identifying and tracking the head center of gravity in the high speed movies are recommended.

##### THREE-YEAR-OLD AND SIX-YEAR-OLD DUMMY

Photographic targets are required to identify the head center of gravity and the pivot points of the knees of the three-year-old and six-year-old dummy. Adhesive backed paper or fabric targets having a pattern that facilitates identifying and tracking of the head and knee reference points in the high speed movies are recommended. The head center of gravity is identified by the head center of gravity reference pin, which protrudes from each side of the head. Note that the head center of gravity target is not used for maximum forward excursion measurements. It may be used, however, along with a second target placed on the head to facilitate determination of maximum head/torso angle. The knee pivot-points are defined by the centers of the knee pivot bolts and are used for maximum forward excursion measurements.